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TRAFFIC CONTROL AT STOP SIGN APPROACHES





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TRAFFIC CONTROL AT STOP SIGN APPROACHES

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in cooperation with

Kentucky Transportation Cabinet
Commonwealth of Kentucky

and

Federal Highway Administration
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EXECUTIVE SUMMARY

The objectives of this report were to: a) determine the number of crashes in Kentucky involving a driver disregarding a stop sign and the locations where these occur, b) determine the characteristics of these crashes, c) investigate locations with a large number of this type of crash, and d) make recommendations to reduce the probability of a driver disregarding a stop sign. The majority of the analyses involved a review and analysis of crashes where a stop sign was listed as the traffic control and “disregarding the traffic control” was listed as a contributing factor. Intersections having a high number of this type of crash were identified with most of these intersections inspected. Using the results of the analysis, recommendations were made which could be considered to reduce the number of this type of crash.

1.0 INTRODUCTION

A traffic crash occurring as a result of a driver disregarding a stop sign has the potential to be a severe collision since it typically involves a right angle type of impact. Various types of traffic control measures can be used to reduce the probability that such a crash will occur. The objectives of this study were to: a) determine the number of this type of traffic crash which occur across Kentucky and the locations where they occur, b) determine the characteristics of these crashes, c) inspect locations with a large number of this type of crash, and d) make recommendations to reduce the probability of a driver disregarding a stop sign.

2.0 PROCEDURE

The literature was reviewed to locate other studies in which crashes where a driver disregarded a stop sign were analyzed.

The computer file of all reported crashes in Kentucky was analyzed to identify crashes where a stop sign was listed as the traffic control and “disregarding the traffic control” was listed as a contributing factor. Data for the five-year period of 1998 through 2002 were included in the analysis.

The characteristics of crashes in which a driver disregarded a stop sign was compared to all traffic crashes. Intersections having a high number of this type of crash (in the three years of 2000 through 2002) were identified with most of those intersections inspected. The crash reports for all fatal crashes were obtained with a site visit then made to most locations. A county having a relative high number and percent of this type of crash was selected for a more detailed analysis.

Board of Claims cases were reviewed to determine those in which the claim was based on an alleged problem with the traffic control at a stop sign approach. Data from these claims were summarized.

The results of the various types of analysis were used to make recommendations which could be considered to reduce the number of this type of crash.

3.0 RESULTS

3.1 Review of Literature

There have been several studies which investigated crashes at intersections where right of way is controlled by a stop sign. The studies have generally found that the severe angle collisions which occur at these intersections are most often caused by a driver stopping at the stop sign and then pulling into the path of an oncoming vehicle. This finding was confirmed in a recent investigation of crashes on newly opened roads in Kentucky where it was found that a driver disregarded the stop sign in only a small number of angle crashes at intersections (1).

The Manual on Uniform Traffic Control Devices (MUTCD) has standard signs to use at stop approaches (2). Some studies have dealt with drivers understanding the right of way conditions at a stop sign; specifically, an issue has been drivers understanding whether the intersection was controlled by a two way or four way stop (3, 4, 5, 6). Recommendations have been made for supplemental signs to ensure drivers would not misinterpret the right of way to be all-way stop controlled. One study noted various conditions where drivers may misinterpret a two-way stop intersection as a four-way stop intersection (3).

Various methods have been suggested to alert drivers to the stop condition and decrease the approach speed to the stop sign. In addition to the typical signs described in the MUTCD, these methods include transverse paint stripes or rumble strips (7) or yellow bar markings (8) on the stop approach in advance of the stop condition.

A study of driver compliance with stop-sign control at low-volume intersections found that the stop violation rate decreased with increasing major-roadway volume and the violation rate was higher when sight is unrestricted than when sight is restricted (9). No correlation was found between stop sign violation rates and crashes. It was concluded that operational effectiveness could be enhanced with no observed safety detriment by the application of no sign control below a major-roadway volume of 2,000 ADT, yield-sign control at a major-roadway volume between 2,000 and 5,000 ADT, and stop sign control or signalization above 5,000 ADT. Another study also reported that violation rates decreased with increasing volumes on the major highway (5).

Typically, additional traffic control measures are installed if a crash trend of drivers failing to stop at a stop sign is noted. The following progressive approach of additional traffic control was listed as a case study: install stop ahead sign, increase size of stop and stop ahead signs, install transverse rumble device, and install intersection beacon (10).

A possible enhancement to stop signs is the use of flashing LED lights around the perimeter of the sign (11) or an internally illuminated stop sign (12). In both instances, the purpose is to increase the visibility of the stop sign.

3.2 Crash Characteristics

Only about 0.70 percent of all traffic crashes on all public highways in Kentucky have involved a driver disregarding a stop sign compared to about 1.46 percent of fatal crashes. This percent is lower when only state-maintained roads are considered (0.36 percent of all crashes and 1.38 percent of fatal crashes). The lower percentage could be related to the types of traffic control devices used on state-maintained roads compared to other roads. Following is a summary of the number of this type of crash found from a summary of crash records from 1998 through 2002. It should be noted that, while about 33 percent of all the crashes occurred on a state-maintained road, about 80 percent of the fatal crashes were on a state-maintained road. This could be related to higher travel speeds.

CRASHES INVOLVING STOP SIGN TRAFFIC CONTROL AND
 “DISREGARDING TRAFFIC CONTROL” AS A CONTRIBUTING FACTOR

<u>YEAR</u>	<u>ALL PUBLIC ROADS</u>		<u>STATE MAINTAINED ROADS</u>	
	<u>TOTAL</u>	<u>FATAL</u>	<u>TOTAL</u>	<u>FATAL</u>
1998	864	9	292	6
1999	849	10	281	5
2000	999	12	365	11
2001	948	15	302	12
2002	924	9	286	8

The characteristics of all traffic crashes on public roads were compared to those crashes in which a driver disregarded a stop sign. Following is a summary of the comparisons.

<u>VARIABLE</u>	<u>COMPARISON</u>
Severity	Crashes involving a driver disregarding a stop sign (46 percent involving an injury) were more severe than all crashes (30 percent involving an injury).
Day of Week	The percentages on weekends were very similar.
Number of Vehicles	A much lower percentage of stop sign related crashes involved a single vehicle (5.6 percent compared to 24.4 percent).
Road Surface	A slightly lower percentage of stop sign related crashes was on a wet surface (17.6 percent compared to 20.9 percent).
Roadway Character	The percentages of stop sign related crashes involving a grade (21.7 compared to 26.7 percent) or curve (9.1 compared to 19.8 percent) was lower.
Land Use	The percent of stop sign related crashes was lower in rural areas (17.4 compared to 30.1 percent) and higher in residential areas (50.0 percent compared to 21.9 percent).
Light Condition	There were no major differences.
Time of Day	There were no major differences.
Month	There were no major differences.

VARIABLECOMPARISON

Contributing Factors

Environmental

The percent involving a slippery surface was less for stop sign related crashes (5.5 compared to 12.1 percent).

Vehicular

No major differences were noted.

Vehicle Type

The percentage of non-passenger cars was slightly lower for crashes at stop signs (3.4 percent compared to 6.2 percent).

3.3 High Crash Intersections

The intersections with the highest number of this type of crash were identified. The number of crashes for the three-year period of 2000 through 2002 was used to identify the intersections. The first type of analysis considered crashes which had a route and milepoint assigned showing it occurred on a state maintained road. Following is a list of intersections which had three or more of this type of crash in the three-year period.

<u>COUNTY</u>	<u>INTERSECTION</u>	<u>NUMBER CRASHES</u>
Harlan	KY 38 and KY 72	11
Madison	US 421 and KY 1016	9
Pulaski	KY 2292 and Ford Drive	8
Warren	KY 880 and Access Road	6
Boyd	US 60 and Montgomery Avenue	5
Daviess	KY 2235 (Triplett Street) and Third Street	5
Jessamine	KY 169 and North Central Avenue	5
Hardin	KY 251 and West Poplar Street	5
Jefferson	KY 2048 and Willis Avenue	4
Woodford	US 62 and KY 1681	4
Anderson	Bluegrass Parkway exit ramp and US 127	3
Bell	KY 2401 and Dorchester	3
Daviess	KY 54 and Allen Street	3
Fayette	US 25 frontage road and Patchen Drive	3
Hardin	KY 313 - Knox Avenue	3
Harrison	KY 32 at Elmarch Avenue	3
Henderson	US 41A and KY 425	3
Lewis	KY 59 and KY 344	3
Logan	KY 79 and North Breathitt Street	3
Meade	KY 79 and KY 228	3
Owen	KY 227 and KY 355	3

COUNTYINTERSECTIONNUMBER CRASHES

Scott	KY 1962 and KY 1963	3
Union	US 60B and KY 2091	3
Warren	KY 242 and KY 884	3
Whitley	KY 727 and Poplar Street	3

A site visit was made to 24 of the 26 intersections. Following is a summary of observations from the site visits and review of the crash data for each intersection.

Harlan County, KY 38 and KY 72

The intersection is in the business district of Harlan. There are four approaches with traffic on KY 72 required to stop. Only 2 of the 11 crashes occurred during darkness with some roadway lighting installed. Four were on a wet pavement. The driver disregarding the stop sign was almost equally distributed with five northbound and six southbound. Three of the drivers were not from the immediate area. One driver stated he was not from the area and thought the intersection was a four way stop and another driver stated he did not see the stop sign. There are currently dual stop ahead and stop signs with a stop bar and crosswalks and the “stop” word message placed on the pavement just prior to the stop bar. Additional traffic control has reduced the number of crashes from eight in 2000 to two in 2001 and one in 2002.

Madison County, US 421 and KY 1016

This intersection has a “Y” configuration with three approaches and the KY 1016 approach stopping. It is in a rural area with a 55 mph speed limit. Five of the nine crashes were during darkness with no roadway lighting present. Four were on a wet pavement. Three of the drivers who ran the stop sign were from out of state and one was from a county not close to the accident site. There was a fatal crash at this intersection in 1998 in which the driver stated he did not observe the stop sign. There were two crashes in 2000, three in 2001, and four in 2002. Signs consist of one 48-inch stop sign and one stop ahead sign with no stop bar or intersection beacon.

Pulaski County, KY 2292 and Ford Drive

This intersection is in the business section of Somerset with the speed limit 45 mph. It has four approaches with a four-way stop condition. Six of the eight crashes involved a driver northbound on KY 2292 (Monticello Street) failing to stop. All eight crashes were during daylight with only one on a wet pavement. All the drivers were local with one stating he was not familiar with the intersection. Seven of the crashes were in 2001. There are currently dual 48-inch stop ahead and stop signs on KY 2292 with one stop sign on Ford Drive. Stop bars are provided on all approaches. There is roadway lighting in one quadrant.

Warren County, KY 880 and Access Road

A review of the crash reports showed that these crashes involved a driver stopping and then disregarding a sign which limited drivers to right turns only from 6 am to 6 pm. Collisions occurred when drivers attempted to cross the intersection or make a left turn.

Boyd County, US 60 and Montgomery Avenue

This intersection is in the business section of Ashland with the speed limit 35 mph. It has four approaches with stop signs on Montgomery Avenue. Drivers who disregarded the stop sign were eastbound in four of the five crashes. Three of the crashes occurred during darkness with the roadway lighting on. One driver was out of state and two were from surrounding counties.

Daviess County, KY 2235 (Triplet Street) and Third Street

This intersection is in a business area of Owensboro with a speed limit of 30 mph. Drivers on Third Street must stop. Four of the five crashes involved an eastbound vehicle. Two crashes occurred during darkness. Triplet Street is a one way street. There is one 30-inch stop sign (high intensity sheeting) with a “cross traffic does not stop” sign on each stop approach.

Jessamine County, KY 169 and North Central Avenue

This is a four-way stop intersection in a residential area of Nicholasville. Four of the five crashes involved a driver on KY 169 not stopping. There is one stop sign and a stop ahead sign on KY 169 with one stop sign on North Central Avenue. Stop bars are provided on all approaches.

Hardin County, KY 251 and West Poplar Street

This is a four-way stop intersection in a school area in Elizabethtown with a speed limit of 35 mph. There are four lanes on KY 251 (North Miles) with two on West Poplar Street. Four of the five crashes involved a driver in the left of the two westbound lanes on KY 251 not stopping. There is one 30-inch stop sign on each approach. There is a stop bar and crosswalks on each approach.

Jefferson County, KY 2048 and Willis Avenue

This four-way stop intersection is in a residential area of Louisville with a speed limit of 35 mph on KY 2048 (Cannons Lane) and 25 mph on Willis Avenue. All four crashes involved a driver on KY 2048 disregarding the stop sign with three northbound. There is one stop sign on each approach with a stop ahead sign on the Cannons Lane approaches. There are stop bars and crosswalk markings on each approach.

Woodford County, US 62 and KY 1681

This intersection has four approaches with a four-way stop condition. It is in a rural area

with a 55 mph speed limit. An intersection beacon is provided. There is one stop sign and a stop ahead sign with a stop bar on each approach. In all four crashes the driver indicated he did not see the stop sign. Fog was a contributing factor in two crashes. Possible view limitations are trees close to the road while one stop sign is offset to the right due to a gravel area.

Anderson County, Bluegrass Parkway exit ramp and US 127

The three crashes at this location involved a driver who did not stop at the sign at the end of the exit ramp from eastbound on the Bluegrass Parkway. There are dual stop and stop ahead signs with no stop bar. There is a wide paved area at the end of the exit ramp with the stop sign on the right side of the ramp a substantial distance to the right of the approach.

Bell County, KY 2401 and Dorchester Avenue

This four-way stop intersection is in a residential area of Middlesboro. The speed limit is 25 mph. There is one stop sign on each approach. The drivers who failed to stop were traveling on KY 2401 (30th Street). The KY 2401 approaches have parking on the side with a total pavement width of 60 feet which places the stop sign to the right of the typical viewing angle. A stop bar and crosswalks are provided on each intersection.

Daviess County, KY 54 and Allen Street

This intersection is in a business area of Owensboro with a speed limit of 35 mph on KY 54. Traffic on Allen Street must stop. All three crashes involved a southbound driver on Allen Street. Two drivers stated they did not see the stop sign. Parking is allowed along Allen Street. There is one 24-inch stop sign with a “cross traffic does not stop” sign on each Allen Street approach.

Fayette County, US 25 frontage road and Patchen Drive

This intersection is between the frontage road beside US 25 and Patchen Drive. It is in a business area of Lexington with a 25 mph speed limit. In two of the three crashes the driver stated he did not see the stop sign with a notation on one report that the sign was partially obstructed by a tree. All of the crashes involved a southbound driver on the frontage road disregarding the stop sign. Parking is allowed on both sides of the frontage road. There are no stop bars, and a 24-inch stop sign is used.

Hardin County, KY 313 and Knox Avenue

KY 313 (Joe Prather Highway) stops at Knox Avenue. All three crashes occurred during darkness with each driver stating he did not see a stop sign and did not realize KY 313 was

ending. There is a stop ahead sign and stop bar. There is 48-inch stop sign which is located a significant distance to the right of the stop approach due to the width of the pavement with another stop sign placed on the bank opposite the KY 313 approach. There is one light at the intersection.

Harrison County, KY 32 and Elmarch Avenue

This is a four-way stop intersection in a residential area in Cynthiana. The speed limit on KY 32 (Pike Street) is 35 mph with a speed limit of 25 mph on Elmarch Avenue. All three crashes occurred during daylight on a dry roadway with a driver on KY 32 disregarding the stop sign. Each approach has one stop sign and one stop ahead sign. There is a stop bar and crosswalks on each approach.

Henderson County, US 41A and KY 425

This is a four-way stop intersection near Henderson. The speed limit is 55 mph on all approaches. The driver in one of the three crashes stated she thought it was a two-way stop. All the crashes occurred during daylight with one on a wet pavement. Traffic control devices at the intersection consist of a flashing beacon, one 48-inch stop sign on each approach, rumble strips on all approaches, a stop bar on each approach, and 48-inch stop ahead signs (two on the KY 425 approaches and one on the US 41A approaches).

Lewis County, KY 59 and KY 344

This intersection is in a rural area with a speed limit of 55 mph. It has three approaches with the stop condition for southbound traffic on KY 59. One crash involved a single vehicle. One crash occurred during darkness (with no roadway lighting) and one occurred on a wet pavement.

Logan County, KY 79 and North Breathitt Street

This intersection is in a residential area of Russellville with a speed limit of 25 mph. Traffic on the two approaches on North Breathitt Street stop. The traffic control on each stop approach consists of a 30-inch stop sign.

Meade County, KY 79 and KY 228

One of the three crashes at this intersection involved a fatality. This section of KY 79 is part of a bypass around Brandenburg. Traffic on the KY 228 approaches stop. All of the crashes involved a driver eastbound on KY 228 not stopping. The speed limit on this approach is 55

mph. Currently there are dual stop and stop ahead signs, a stop bar, and rumble strips on this approach.

Owen County, KY 227 and KY 355

The intersection is in a rural area with a speed limit of 55 mph. The intersection has three approaches with drivers on the northbound KY 355 approach stopping. All three crashes were single vehicle and occurred during darkness with no roadway lighting installed. There are dual stop ahead signs installed with a 48-inch stop sign and an arrowboard at the guardrail across from the stop approach. There is no stop bar.

Scott County, KY 1962 and KY 1963

There are three approaches at this intersection with traffic on KY 1963 stopping. There is a single stop sign at the intersection with no stop bar.

Union County, US 60B and KY 2091

The bypass was opened in January 2002. Two fatal crashes occurred within the first month with both involving a local driver not stopping. The third crash occurred in September 2002 and also involved a local driver. Sight distance to each stop sign is not limited and adequate traffic control devices were installed. The crashes appear to be related to local drivers not accustomed to stopping at the new intersection.

Warren County, KY 242 and KY 884

This intersection is in a rural area with a speed limit of 55 mph. There are four approaches with traffic on KY 884 required to stop. There is one stop sign and one stop ahead sign on the KY 884 approaches with the stop word message on the pavement just prior to the stop sign.

Whitley County, KY 727 and Poplar Street

This intersection is in a residential area of Corbin with a speed limit of 25 mph. There are four approaches with traffic stopping on Poplar Street. There is one stop sign on each approach. This intersection is one of a series of intersections along Poplar Street where traffic is required to stop.

Crashes were also summarized at intersections which did not involve a state-maintained highway. Following is a list of the intersections on these roads with four or more crashes in the three-year period of 2000 through 2002. There were 21 additional intersections in which three crashes occurred (eight in Jefferson County, four in Daviess County, three in Fayette County, two in Boyd and Jefferson Counties, and one in Hardin and Mercer Counties).

<u>COUNTY</u>	<u>INTERSECTION</u>	<u>NUMBER CRASHES</u>
Fayette	Pine Street and Upper Street	7
Daviess	Ninth Street and Allen Street	7
Daviess	Third Street and Center Street	7
Daviess	Third Street and Cedar Street	7
Fayette	Wilson Downing Road and Belleau Wood/Walden Drive	7
Daviess	Ford Avenue and Robin Road	6
Daviess	Third Street and Hathaway Street	6
Fayette	Armstrong Mill Road and River Park Drive	6
Hardin	Dolphin Drive and Mary T. Meagher Drive	6
Jefferson	Floyd Street and Lee Street	6
Pike	Second Street and Pike Street	6
Bell	Fifteen Street and Salisbury Avenue	5
Bullitt	Old US Highway 61 and Hillview Boulevard	4
Daviess	Hill Avenue and South Griffith Avenue	4
Daviess	Seventh Street and J.R. Miller Boulevard	4
Daviess	Third Street and St. Elizabeth Street	4
Fayette	Eastland Drive and Industry Road	4
Fayette	Zandale Drive and Bellefonte Drive	4
Jefferson	Chamberlain Lane and Collins Lane	4
Jefferson	Furman Avenue and Stanton Avenue	4
Kenton	Anderson Road and Western Reserve Road	4

A site visit was also made to all of these intersections. It should be noted that there were 22 crashes at the intersection of Shive Lane and the US 231 access road in Warren County in which the traffic control is a stop sign and the contributing factor was listed as disregarding the traffic control. However, these crashes did not involve a driver not stopping at the stop sign. The crashes involved a driver attempting to cross Shive Lane or turn left although regulatory signs and pavement markings limited drivers to a right turn only. Following is a summary of observations from the site visit and review of the crash data for each intersection.

Fayette County, Pine Street and Upper Street

This intersection is in a residential area in Lexington near the University of Kentucky campus. The speed limit on Upper Street, which is the through one-way street, is 35 mph. There are two approaches on Pine Street which must stop. The speed limit on Pine Street is 25 mph. All seven crashes involved a westbound vehicle. In three crashes the driver noted he did not see the stop sign with two of these occurring during darkness (with roadway lighting). There is on

street parking with street trees on the westbound approach. One 24-inch stop sign is provided with a portion of a stop bar remaining at the time of the site visit.

Daviess County, Ninth Street and Allen Street

This intersection is in the business section of Owensboro with a speed limit of 30 mph. There are four approaches with traffic on Allen Street required to stop. Six of the seven crashes involved a southbound vehicle. Two crashes occurred during darkness. There is one 30-inch stop sign (engineering grade sheeting) with a “cross traffic does not stop” sign and one stop ahead sign on each Allen Street approach. There is no stop bar. Allen Street is a wide street with parking on both sides.

Daviess County, Third Street and Center Street

This intersection is in a residential area in Owensboro with a speed limit of 30 mph. The intersection has four approaches with drivers on Center Street required to stop. All seven crashes involved a driver northbound on Center Street failing to stop. Three drivers stated they did not see a stop sign with one stating he thought traffic on Third Street had to stop. On the northbound approach there is one 30-inch stop sign with high intensity sheeting while there is one 24-inch stop sign with engineering grade sheeting on the southbound approach. Parking is allowed on both sides of Center Street.

Daviess County, Third Street and Cedar Street

This intersection is in a business area in Owensboro with a speed limit of 30 mph. The intersection has four approaches with Third Street traffic required to stop. Four of the drivers who disregarded the stop sign were westbound with three eastbound. Three of the westbound drivers and one eastbound driver stated they did not see the stop sign. One driver stated a parked truck blocked his view. There is a 30-inch stop sign with a “cross traffic does not stop sign” on each Third Street approach. There are crosswalks but no stop bar. Parking is allowed on both sides of Third Street.

Fayette County, Wilson Downing Road and Belleau Wood/Walden Drive

This is a four-way stop intersection in a residential area of Lexington with a speed limit of 35 mph. All of the seven crashes involved a driver on Wilson Downing Road (which is a collector type of street) disregarding the stop sign. Five of the crashes involved a westbound driver on Wilson Downing Road. Two of the crashes occurred during darkness with roadway lighting. There are stop bars on each approach and a stop ahead sign on the Wilson Downing Road approaches. The speed limit is 35 mph. The westbound approach has a 24-inch stop sign

while the eastbound approach has a 30-inch stop sign.

Daviess County, Ford Avenue and Robin Road

This four-way stop intersection is in a residential area in Owensboro with a speed limit of 30 mph. All six drivers who disregarded the stop sign were on Ford Avenue with five eastbound. Each approach has a 36-inch stop sign. There is no stop ahead sign or stop bar. The streets are wide with parking allowed.

Daviess County, Third Street and Hathaway Street

This intersection is in a residential area in Owensboro with a speed limit of 30 mph. The intersection has four approaches with drivers on Hathaway Street required to stop. All six drivers involved a driver southbound on Hathaway Street failing to stop with two indicating they did not see the stop sign. Each stop approach has a 30-inch stop sign.

Fayette County, Armstrong Mill Road and River Park Drive

This four-way stop intersection is in a residential area of Lexington with a speed limit of 35 mph. All of the drivers who disregarded the stop sign were traveling on Armstrong Mill Road. Two crashes were during darkness (with roadway lighting) with two on a wet pavement. There are dual stop signs on Armstrong Mill Road. One approach has dual stop ahead signs while one approach has one stop ahead sign. A stop bar is provided on all approaches.

Hardin County, Dolphin Drive and Mary T. Meagher Drive

Traffic on Meagher Drive is required to stop at this intersection which is in a business area of Elizabethtown. The speed limit is 25 mph. Five of the six crashes involved an eastbound driver failing to stop. Only one crash occurred during darkness with none on a wet pavement. Traffic control consists of a 30-inch stop sign with a “cross traffic does not stop” sign. There is no stop bar.

Jefferson County, Floyd Street and Lee Street

This four-way stop intersection is located in a business area in Louisville. All six of the crashes involved a driver northbound on Floyd Street not stopping at the stop sign. None of the crashes occurred during darkness. There is one stop sign and a stop bar on all approaches. There is a wide width between curbs with parking allowed on both sides of the street.

Pike County, Second Street and Pike Street

This intersection is in downtown Pikeville with a speed limit of 25 mph. Second Street is a narrow one-way street and drivers on this approach must stop. Failure of the driver to observe the stop sign at the corner of the intersection was noted in a couple of crashes.

Bell County, 15th Street and Salisbury Avenue

Traffic on Salisbury Avenue stops at this intersection in a business area of Middlesboro. The speed limit is 35 mph. Four of the five crashes involved a driver westbound on Salisbury Avenue. Two crashes were during darkness. There is a 24-inch stop sign with a 24-inch stop ahead sign with engineering grade sheeting used. There is no stop bar or any roadway lighting.

Bullitt County, Old US Highway 61 and Hillview Boulevard

This intersection is located in a business area of Hillview. Drivers on Old US Highway 61, which has a speed limit of 35 mph, are required to stop. One crash was during darkness. There is one stop sign with a “cross traffic does not stop” supplement on both approaches. One approach has a 30-inch stop sign with high intensity sheeting while the other approach has a 24-inch sign with engineering grade sheeting.

Daviess County, Hill Avenue and South Griffith Avenue

The speed limit is 30 mph at this intersection located in a residential area of Owensboro. Traffic on South Griffith Avenue must stop. Three of the four crashes involved a southbound driver not stopping. One crash occurred during darkness. Each stop approach has a 30-inch stop sign with a “cross traffic does not stop” sign and a stop bar.

Daviess County, Seventh Street and J.R. Miller Boulevard

This intersection is in a residential area of Owensboro with a speed limit of 35 mph. Traffic on J.R. Miller Boulevard must stop. All four crashes involved an eastbound driver not stopping at the stop sign. None occurred during darkness. Each stop approach has a stop sign and “cross traffic does not stop” sign.

Daviess County, Third Street and St. Elizabeth Street

This intersection is in a business area of Owensboro with a speed limit of 30 mph. Traffic on St. Elizabeth Street must stop. Three of the four crashes involved a southbound vehicle. None occurred during darkness. Traffic control consists of one 30-inch stop sign (with engineering grade sheeting) on each stop approach.

Fayette County, Eastland Drive and Industry Road

This is a four-way intersection in a business area of Lexington with a speed limit of 35

mph. Three of the four crashes involved a driver on Eastbound Drive not stopping. Stop ahead signs are installed on Industry Road. There are no stop bars. The stop sign is 30 inches.

Fayette County, Zandale Drive and Bellefonte Drive

This is a four-way intersection in a residential area in Lexington with a speed limit of 35 mph. There were four crashes equally divided between drivers disregarding the stop sign on the two streets. One crash occurred during darkness (with roadway lighting) with one on a wet pavement. There are stop bars and a 30-inch stop sign.

Jefferson County, Chamberlain Lane and Collins Lane

This intersection is in a business/industrial area in Louisville. Drivers on Collins Lane must stop. All four crashes involved a westbound driver on Collins Lane not stopping. Two occurred during darkness with one on a wet surface. Each approach has one stop and stop ahead sign with a stop bar. It was noted that a traffic signal is being installed at the intersection.

Jefferson County, Furman Avenue and Stanton Avenue

This four-way stop intersection is in a residential area in Louisville with a speed limit of 25 mph. Traffic control consists of one 24-inch stop sign with stop bar and crosswalk markings.

Kenton County, Anderson Road and Western Reserve Road

This four-way stop intersection is in a business area in Crescent Springs. The speed limit is 35 mph on Anderson Road and 25 mph on Western Reserve Road. All four of the crashes involved a southbound driver on Anderson Road disregarding the stop sign. There is a substantial downgrade on the southbound approach. There is one stop and one stop ahead sign on each approach as well as a stop bar and crosswalks. All four crashes were on a dry pavement with three during daylight conditions.

3.4 Trial County

Following is a list of the counties having the largest number of crashes where a driver disregarded a stop sign along with a percentage of this type of crash of all crashes in the county. Data for the five years of 1998 through 2002 were included.

<u>COUNTY</u>	<u>NUMBER</u>	<u>PERCENT OF TOTAL</u>
Jefferson	998	0.76
Fayette	471	0.74
Daviess	356	2.07
Warren	237	1.15

McCracken	227	1.70
Kenton	143	0.51
Christian	136	1.42
Henderson	104	1.08

Considering both the number and percent of this type of crash, Daviess County was selected as the trial county. The number of crashes from 1998 through 2002 were summarized by intersection. It should be noted that several intersections in Owensboro were previously listed when the intersections having the highest number of crashes from 2000 through 2002 were identified. Most of those intersections were on non-state maintained streets. Following is a list of the intersections which had five or more crashes in the five years of 1998 through 2002. It should be noted that several of the intersections were on Third Street.

<u>INTERSECTION</u>	<u>NUMBER</u>
Third Street and Cedar Street	13
Third Street and Center Street	10
Third Street and Hathaway Street	10
Ninth Street and Allen Street	7
Third Street and Locust Street	6
Ford Avenue and Robin Road	6
Scherm Road and Lewis Lane	6
Seventh Street and J.R. Miller Boulevard	6
Triplett Street (KY 2235) and Third Street	5
Ford Avenue and Griffith Avenue	5
Hill Avenue and South Griffith Avenue	5
Locust Street and Eleventh Street	5
Third Street and St. Elizabeth Street	5

A site visit was made to these intersections. Following is a summary of the findings from the site visit and review of the crash data for each intersection.

Third Street and Cedar Street

This intersection is in a business area with a speed limit of 30 mph. Drivers on Third Street must stop. Nine of the 13 crashes involved a westbound driver. Two crashes occurred during darkness with only one on a wet pavement. Drivers in five crashes stated they did not see the stop sign with one driver noting that a parked truck blocked the view of the stop sign. Parking is allowed on both sides of Third Street. For westbound drivers, this was the first intersection requiring them to stop after several intersections where traffic on the other street had to stop. One stop sign is provided with a “cross traffic does not stop” sign. There are crosswalk markings with no stop bar.

Third Street and Center Street

This intersection is in a residential area with a speed limit of 30 mph. Traffic on Center Street must stop. All 10 crashes involved a northbound driver disregarding the stop sign. For northbound drivers, there is a stop sign with no stop ahead sign or stop bar. In four crashes the driver stated he did not see the stop sign while in two other crashes the driver stated he thought the other driver must stop. Only one crash occurred during darkness.

Third Street and Hathaway Street

This intersection is in a residential area with a speed limit of 30 mph. Traffic on Hathaway Street must stop. All 10 crashes involved a southbound driver disregarding the stop sign. In three crashes the driver stated he did not see the stop sign. Only one crash occurred during darkness. Each stop approach has a 30-inch stop sign. There is no stop bar.

Ninth Street and Allen Street

This intersection is in the business section of Owensboro with a speed limit of 30 mph. There are four approaches with drivers on Allen Street required to stop. Six of the crashes involved a southbound vehicle. Two crashes occurred during darkness. There is one 30-inch stop sign (engineering grade sheeting) with a “cross traffic does not stop” sign and one stop ahead sign on each Allen Street approach. There is no stop bar. Allen Street is a wide street with parking on both sides.

Third Street and Locust Street

This intersection is in a business area with a speed limit of 30 mph. Traffic on Third Street must stop. All six crashes occurred in 1998. Four involved an eastbound vehicle. One crash was during darkness. Right of way is currently controlled by a traffic signal.

Ford Avenue and Robin Road

This four-way stop intersection is in a residential area with a speed limit of 30 mph. All six drivers who disregarded the stop sign were on Ford Avenue with five eastbound. There is a 36-inch stop sign on each approach.

Scherm Road and Lewis Lane

This four-way stop intersection is in a residential area with a speed limit of 30 mph. All six drivers who disregarded the stop sign were on Scherm Road with three in each direction. One crash occurred during darkness. Traffic control on each approach consists of a 36-inch stop sign with high intensity sheeting.

Seventh Street and J.R. Miller Boulevard

This intersection is in a residential area with a speed limit of 35 mph. Traffic on Seventh Street must stop. All six drivers who disregarded the stop sign were traveling eastbound. One crash occurred during darkness. Each stop approach has a stop and “cross traffic does not stop” sign.

Triplett Street (KY 2235) and Third Street

This intersection is in a business area with a speed limit of 30 mph. Traffic on Third Street must stop. Four of the five crashes involved an eastbound vehicle. Two crashes occurred during darkness. There is one 30-inch stop sign (high intensity sheeting) with a “cross traffic does not stop” sign on each stop approach.

Ford Avenue and Griffith Avenue

This intersection is in a residential area with a speed limit of 30 mph. Traffic on Griffith Avenue must stop. Four of the five drivers were northbound. There is a 30-inch stop sign on each stop approach. A stop bar had been placed on one approach.

Hill Avenue and South Griffith Avenue

The speed limit is 30 mph at this intersection located in a residential area. Traffic on South Griffith Avenue must stop. Four of the five crashes involved a southbound driver not stopping. One crash occurred during darkness.

Locust Street and Eleventh Street

This intersection is in a residential area with a speed limit of 30 mph. Traffic on Eleventh Street must stop with Locust Street one way. Four of the five crashes involved an eastbound driver on Eleventh Street. Three drivers stated they did not see the stop sign. Locust Street is a one way street. Each stop approach has a 30-inch stop sign with a stop ahead sign on one approach. Eleventh Street is a wide street with railroad tracks down the center of the street.

Third Street and St. Elizabeth Street

This intersection is in a business area with a speed limit of 30 mph. Traffic on St. Elizabeth Street must stop. Four of the five crashes involved a southbound vehicle. One crash occurred during darkness. Traffic control consists of one 30-inch stop sign with engineering grade sheeting on each stop approach.

3.5 Fatal Crashes

There was a total of 55 fatal crashes during the five years in which the traffic control was listed as a stop sign with a contributing factor of disregarding the traffic control. This represented 1.46 percent of all fatal crashes. The number of fatal crashes varied from a high of 15 in 2001 to a low of 9 in 2002 and 1998, 10 in 1999, and 12 in 2000. Following is a list of counties having more than one of this type of fatal crash.

<u>COUNTY</u>	<u>NUMBER</u>
Jefferson	8
McCracken	5
Meade	3
Boyle	2
Marion	2
Marshall	2
Perry	2
Union	2
Warren	2

The only intersection with more than one fatal crash was at the intersection of the US 60B and KY 2091 in Union County. Both of these crashes occurred within the first month of the opening of the bypass around Morganfield. Both involved a local driver who evidently did not recognize the stop condition created by the construction of the new road. The sight distance is over 1,000 feet with the traffic control measures at the time including rumble strips, stop ahead sign, stop sign, and a variable message sign warning of the stop condition.

Of the 55 crashes, 42 were at an intersection involving a state-maintained road. Following is a summary of some of the characteristics of these crashes and the locations at which they occurred.

<u>VARIABLE</u>	<u>NUMBER</u>
Both state maintained roads	30
Both city/county	13
County/city and state maintained	12
Cross roads	35
“T/Y” type intersection	20
Multiple vehicle	50
Single vehicle	5

<u>VARIABLE</u>	<u>NUMBER</u>
Daylight	32
Darkness/highway lighted	12
Darkness/not lighted	6
Dawn/Dusk	5
Dry	50
Wet	5
Residence of driver disregarding stop sign	
In county of crash	28
Other county in Kentucky	16
Out of state	4
Unknown	7
Speed limit on major road	
under 35 mph	6
35 mph	11
45 mph	2
55 mph	36

The data show that only about one-fourth of the crashes did not involve any state maintained road. Slightly over one-third of the fatal crashes occurred at a “T” or “Y” type of intersection. Almost all of crashes were multiple vehicle (91 percent). About 42 percent occurred during non-daylight hours which is higher substantially than the statewide average. Only about 9 percent of the crashes occurred on a wet pavement which is substantially below the statewide average. The residence of the driver who disregarded the stop sign is very similar to the distribution in statewide crashes. The majority of the crashes occurred in a rural area with the speed limit 55 mph for about 65 percent of the drivers disregarding the stop sign. The data showed that no crashes involved a truck driver disregarding the stop sign. No reason was typically given in the narrative description given on the crash report to explain why a driver did not stop at the stop location. The most common explanation, which was given in a few instances, was that the driver did not see the stop sign.

A site visit was made to 43 of these locations. The intersections were selected to include both urban and rural locations and to include all portions of the state. Characteristics of the site and the traffic control were noted. It was apparent that additional traffic control measures had been added after the fatal crash at several of the locations with some locations now having a traffic signal. The site visits revealed several issues which should be considered in the development of recommendations. The size of the stop sign was 24 inches at several county and city roads stop approaches. This was found at some locations when the local road intersected a state-maintained road. The height of the stop sign was less than the 7-foot recommended height at some urban locations. Stop bars were not routinely used. Some crashes occurred at a location

where there was a curve on the approach to the stop condition which resulted in a limited sight distance to the stop sign. A limited view of the stop sign could result from either a view obstruction or the sign being outside the cone of vision of the driver as he approached the sign.

3.6 Board of Claims Cases

A summary of claims made against the Kentucky Transportation Cabinet through the Board of Claims has been prepared for the years of 1981 through 2001 (13). Various codes were used to describe the reason for the claim. Two codes which relate to traffic control at stop sign approaches were “lack of stop sign” and “inadequate signing at stop approaches.” The claims which involved these codes were summarized.

For the years of 1981 through 2001 there were 72 claims involving a stop sign with 42 claims alleging no stop sign and 30 claims noting that there was inadequate signing. The claims were spread across the state with a maximum of five in any county (Meade and Montgomery Counties). Most of these claims were for high claim amounts with 52 claims of \$50,000 or more. The total claim amount for the 72 claims was about \$5.7 million. The summary report (13) noted that 67 of these claims had been decided with 36 dismissed. The total awards for these claims were about \$878,000 or about 17 percent of the claim amount which is very similar to the overall percentage paid for all types of claims.

The claims in which the allegation was that the signing was inadequate typically referred to either a lack of advance warning signs or an obstruction of the view of the stop sign (usually from vegetation). The claims relating to a lack of a stop sign referred to situations where either no stop sign was ever installed and where the stop sign was missing for such reasons as being knocked down or stolen. The length of time the stop sign had been missing was an issue in those cases. In some instances the side road was not state maintained and the responsibility for the placement and maintenance of the signs was an issue.

The largest award for the type of claim was for a missing stop sign which was the result of vandalism. A couple of the largest awards involved brush or tree branches limiting the view of the stop sign. There were a few other substantial awards involving a missing stop sign or inadequate advance warning.

4.0 SUMMARY

About 0.70 percent of all traffic crashes on all public highways in Kentucky involve a driver disregarding a stop sign compared to about 1.46 percent of fatal crashes. This percent is lower when only state-maintained roads are considered (0.36 percent of all crashes and 1.38 percent of fatal crashes). The higher percentage of fatal crashes relates to the angle type of collision which typically occurs when a driver disregards a stop sign.

Intersections having the highest number of this type of crash were identified with these

crashes analyzed and site visits made. The analysis of the crash data was the basis for the development of a list of recommendations to reduce the occurrence of this type of crash.

A review of Board of Claims cases found that there were several cases involving large claim amounts in which the allegation dealt with either the stop sign or stop sign approach. The percent of the claim awarded in these cases was similar to the overall results for all cases.

5.0 RECOMMENDATIONS

The analysis resulted in the following recommendations.

1. The Transportation Cabinet should develop a statewide policy concerning the installation and maintenance of stop signs at intersections of county and city roads with state-maintained roadways. Unless a formal agreement is made with the city or county ensuring the signs are installed appropriately, the Transportation Cabinet should install the stop signs on any road intersecting a state-maintained roadway or inspect the signs to ensure proper installation.
2. There should be expanded use of stop bars on stop approaches with the stop bar placed at a location where the driver will have a clear view of approaching traffic.
3. While engineering grade sheeting is not used on any state-maintained road, this material is used on many city and county roads. Engineering grade sheeting should not be used on stop signs on city and county roads at intersections with state-maintained roads. Consideration should be given to the use of diamond grade sheeting for stop signs at selected locations having high levels of ambient lighting or a nighttime crash problem.
4. It is preferable to maintain a minimum size of stop signs of 30 x 30 inches at all locations. A stop sign less than 30 x 30 inches should not be used unless the speed limit is 25 mph or less in a residential environment, and there is no visibility restriction to the stop sign.
5. Consideration should be given for more use of rumble strips at intersection approaches where the sight distance to the stop condition is limited or the stop sign is at a location where a stop condition would be unexpected in the roadway environment. Thermoplastic striping material may be used to provide both an audible and visual warning.
6. Stop ahead signs should be installed when the sight distance is less than the stopping distance using a design perception reaction time of 2.5 seconds and normal braking (coefficient of friction of 0.3). Using these values results in stopping distances of about 160 feet for 25 mph, 265 feet for 35 mph, 390 feet for 45 mph, and 540 feet for 55 mph.
7. The proper mounting height of 7 feet to the bottom of the sign in urban areas and 5 feet in

rural area should be maintained. A lower height can contribute to a line of sight problem. For example, parking along an urban street can obstruct the view of a stop sign not installed at the proper height.

8. More than typical traffic control should be used when the stop approach is at an acute angle to the through road (“Y-type” intersection). The additional traffic control could be additional or oversized signs, a stop bar, rumble strips, or an intersection beacon.

9. When a new road is opened which includes any intersections where a stop condition was created on a road where no stop was previously required, the public information, enforcement, traffic control, and design measures recommended in a previous report (1), which dealt with opening new roads, should be considered.

10. Several other factors which may indicate the need for additional traffic control devices on a stop approach include: a) a speed limit of 55 mph on the stop approach, b) limited sight distance to the stop sign, c) a vertical curve on the stop approach which limits the view of the cross road, and d) a wide pavement width adjacent to the stop sign location which results in the stop sign being out of the driver’s normal field of view.

11. Dual mounted stop signs should be used if there is a roadway feature which results in the placement of the stop sign on the right side of the road out of the normal field of view. An example would be if there is a righthand curve on the stop approach.

12. The stop approach should be driven to ensure that there are no obstructions to limit the view of the stop sign or other warning signs.

13. Partial lighting or additional delineation should be used when a high percentage of the crashes occur during darkness.

14. Stop signs are not to used as a method to attempt to reduce speeds along a street.

15. Parking should be limited immediately prior to the stop sign to reduce the possible sight obstruction from parked vehicles.

16. The importance of the stop sign should be emphasized to all employees with the policy that the stop sign must be replaced on the day of any notice that it is missing.

17. Fatal crashes where the police report notes a stop sign as the traffic control and “disregarding traffic control” as a contributing factor should be routinely “flagged” and inspected to determine if additional traffic control is needed at that intersection.

6.0 REFERENCES

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